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Magnetic High-Field Phases of Magnetoelectric LiNiPO₄

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In this work the magnetic high-field phases and magnetoelectric properties of LiNiPO₄ are studied up to 30T.

LiNiPO₄ is a member of the family of lithium orthophosphates which are of orthorhombic structure and exhibit the magnetoelectric effect [1]. LiNiPO₄ is a quasi-2D system with long range antiferromagnetic order below T_N=21.8T in zero-field. The magnetic phase diagram of the material has previously been studied up to 17.3T [2,3] and pulsed-field magnetization measurements up to 23T show several additional phase transitions [4].

Here LiNiPO₄ is investigated for fields up to 30T by pulsed high magnetic field time-of-flight Laue neutron diffraction and by magnetization and electric polarization measurements. Two high-field phases were found in agreement with the previous observations. The ordering vectors were determined and possible spin structures were suggested. The polarization measurements show a re-entrance of the magnetoelectric effect for $\mu_0 H \approx 19-21$ T, which points towards a commensurate ferrimagnetic state. However, the behavior of the effect is not fully understood. The effect vanishes above 21T where either a linearly polarized spin structure or a spin spiral is present.

The experimental technique using pulsed high magnetic fields in connection with neutrons is relatively new [5]. Nevertheless, the results displayed here show that the technique presents a future possibility to study high-field phases of certain magnetic materials.

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